USB-FRM02

User's Manual

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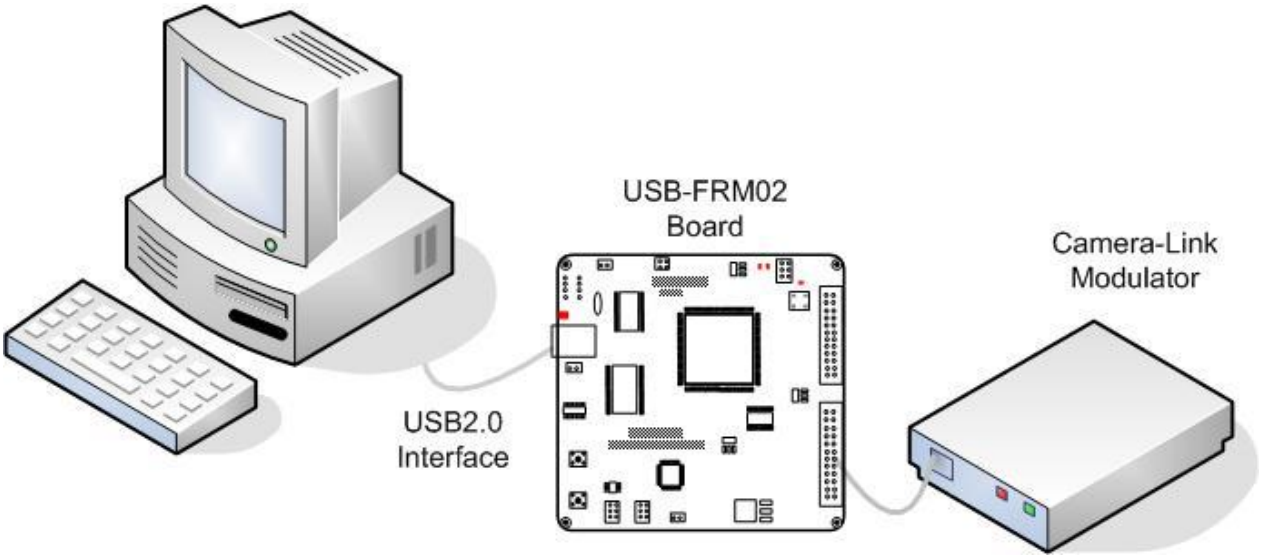
1. Introduction

The USB-FRM02 is a board to receive data from Camera-Link modulator or Image device (3.3 V CMOS Camera) and transmit the received data to the system via USB2.0 interface (High speed : 480Mbps). In addition, it has a 16 general purpose digital inputs and outputs for external controls.

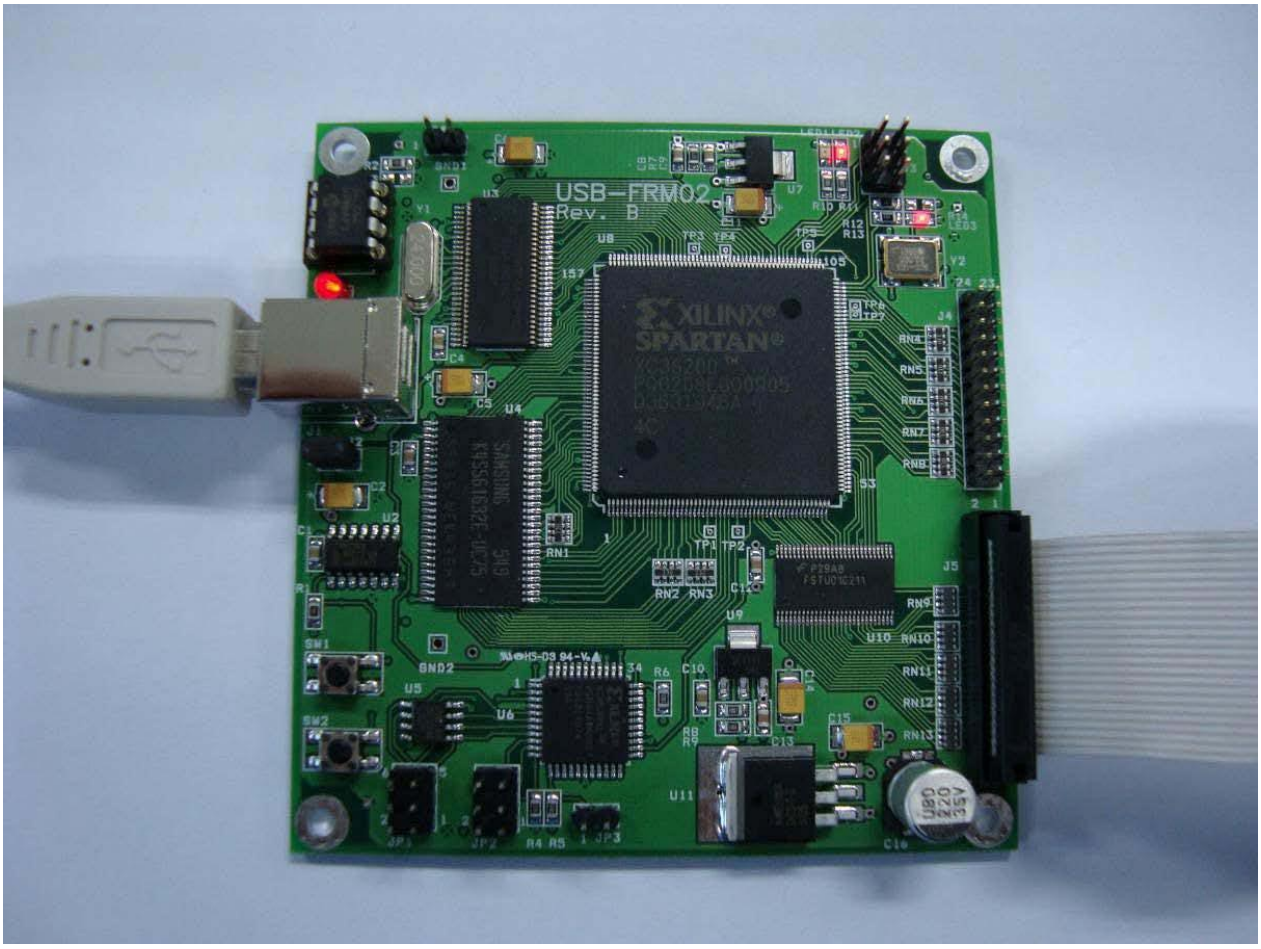
The operation of the board is controlled by API (Application Programming Interface) Program which can be easily installed into your PC. It has two operation modes. One is DXD810 (2048 x 1536 resolution) mode and the other is DXD1417 (3160 x 2564 resolution) mode. The difference between two modes is only the image resolution. You can select its operating mode by using the API functions.

[Figure 1-1] shows connection of the PC with a USB-FRM02 board equipped into the frame grabber.



[Figure 1-1. USB-FRM02 Board Usage]

As shown in Figure [1-1], it receives image frame from the 3.3V CMOS interface and transmits the received data to the system via high speed USB2.0 interface.

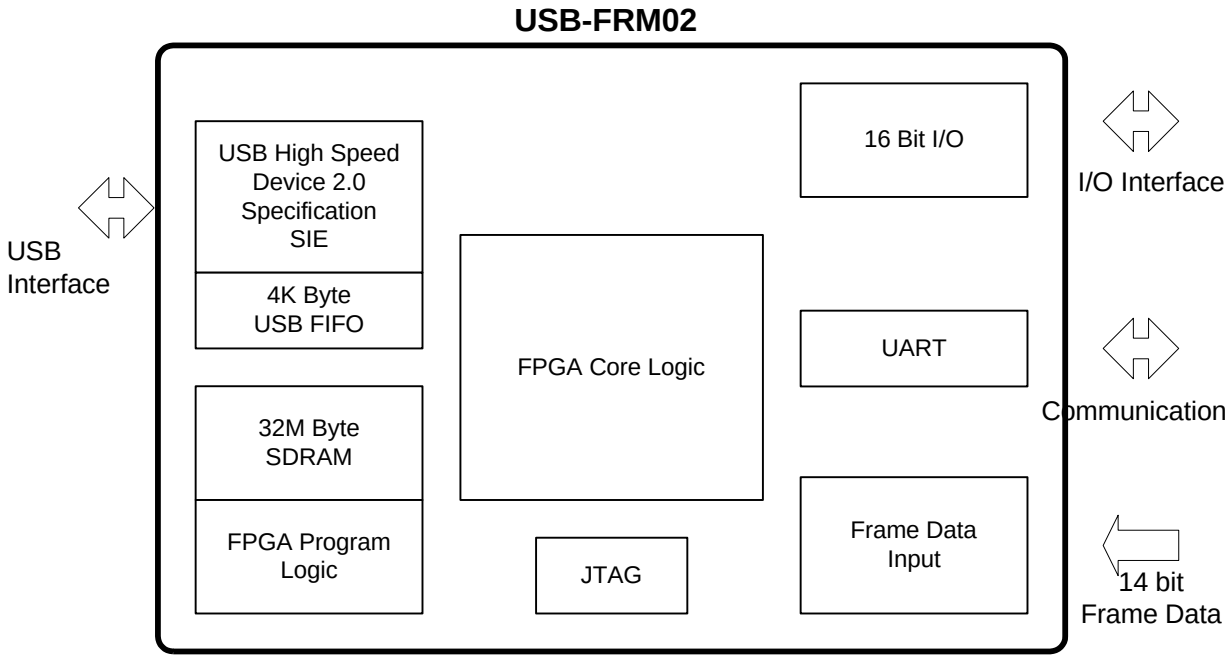


[Figure 1-2. Picture of the USB-FRM02 Board]

[Figure 1-2] shows physical connection of the board USB-FRM02. At the left side, there is USB-B type connector(J1) for communication with your PC. The 24 pin connector(J4) at the upper right side is for General purpose I/O, 24 pin connector(J5) at the lower side is for UART communication and frame data channel.

2. USB-FRM02 Functions

As shown in the following figure, main control of the board is performed in FPGA Core Logic. The primary functions are receiving the frame data, transmitting/receiving UART data and controlling general purpose I/O. These functions are performed by using API through USB 2.0 interface at the PC. The board has 32MByte SDRAM for buffering the frame data.



[Figure 2-1. USB-FRM02 Functional block Diagram]

Programming FPGA Core Logic is performed via the JTAG interface. The logic program of the FPGA is saved in a flash ROM, it is located on the board and loaded at the power-up time.

[Features of the USB-FRM02 Board]

- USB 2.0 Specification, High speed(480Mbps) device
- 32MB SDR-SDRAM for buffering the Frame Data
- Single 5V operation
- Receiving 14-bit frame data acquisition
- UART communication(8 bit data, 1 start, 1 stop, No parity, 9600bps)
- 16 bit General Purpose I/O
- Windows 2000 SP4 or Windows XP SP1above
- Convenient Windows Application Programming Interface(DLL)

3. Installation

After unpacking, inspect the board to make sure there are no damages on the package.

3.1 Package Contents

[Figure 3-1. USB-FRM02 product contents]

Product Contents

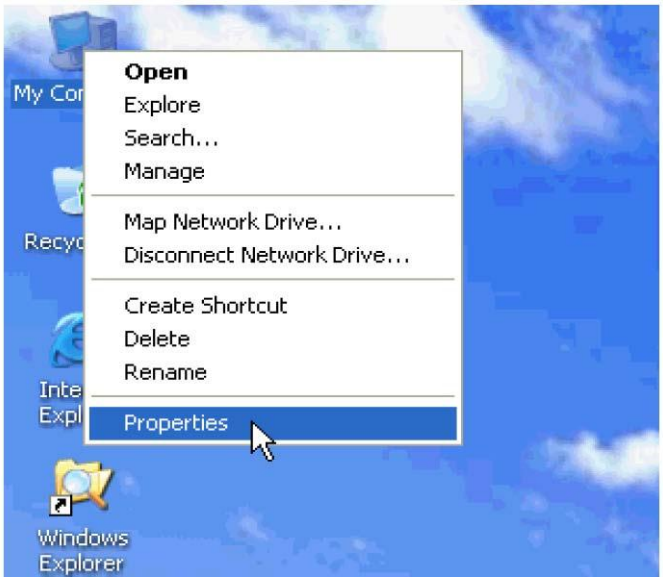
1. USB-FRM02 Board
2. USB(A-B) Cable
3. CD (Driver/Manual/API/Samples etc.)

3.2 Installation Sequence

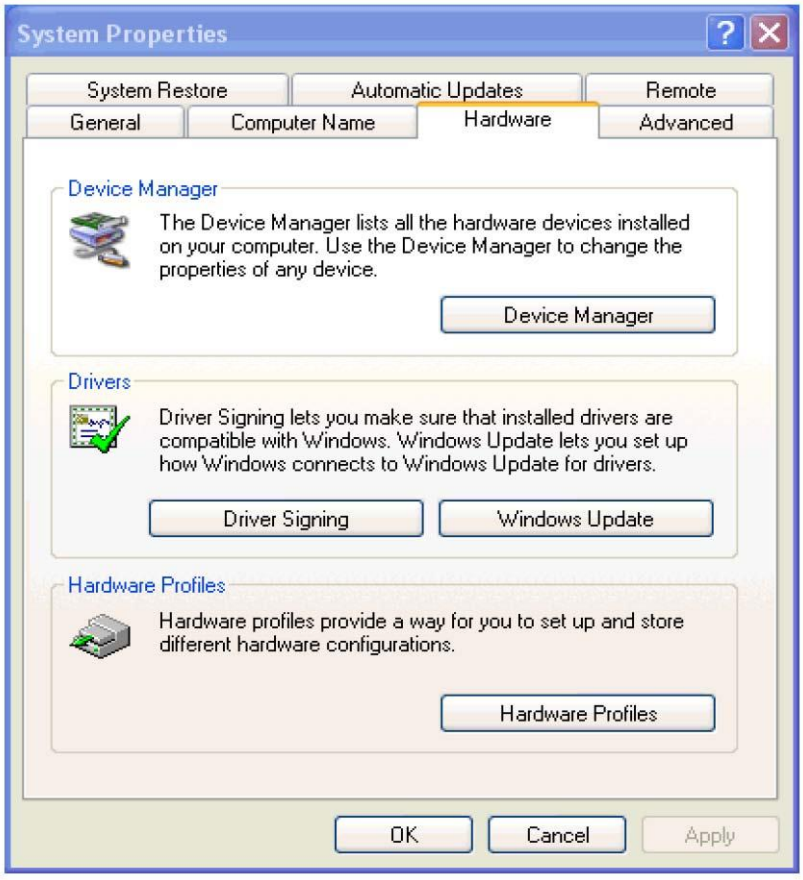
To install USB-FRM02 board in your environment, do the following steps. The USB-FRM02 board is completely Hot-Plug and Plug & Play. Therefore, you can install it easily.

The required PC operating system for the USB-FRM02 is Windows 2000 SP4 or Windows XP SP1 higher. The USB-FRM02 uses USB High Speed interface thus “USB 2.0 Root Hub” should be installed in your PC. You can check this condition by doing the following steps.

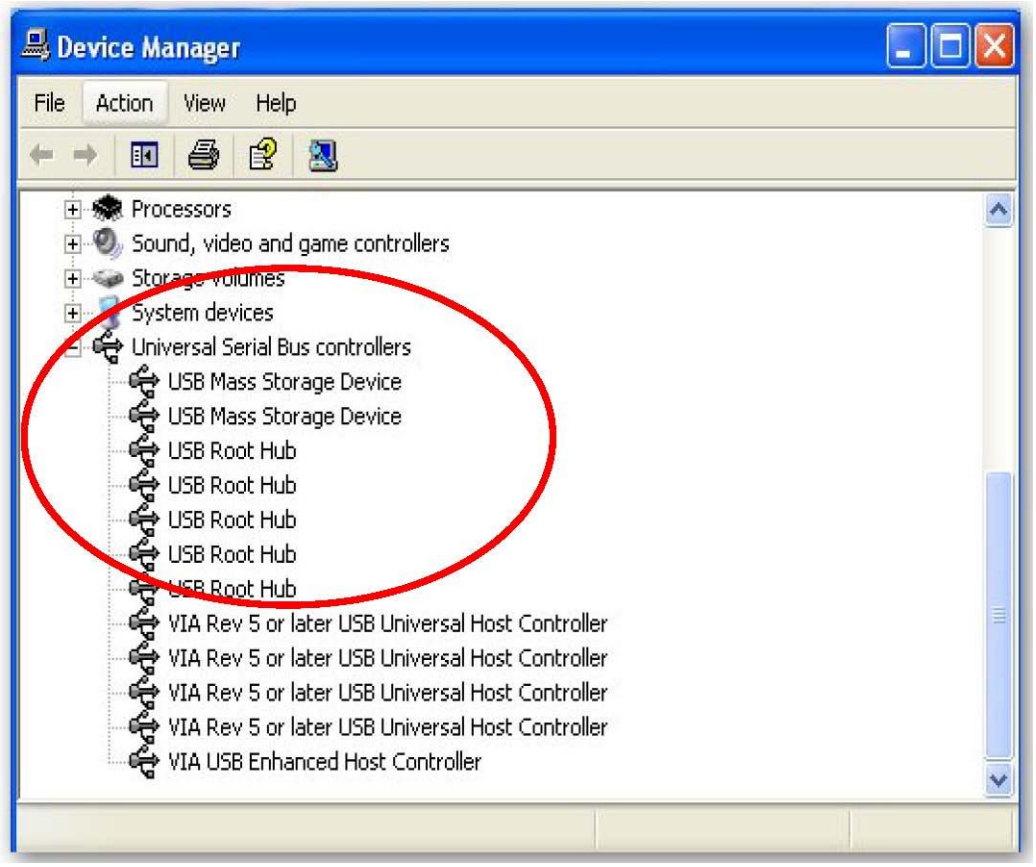
[My Computer -> Properties -> Hardware -> Device Manager -> Universal Serial Bus controllers]



[Figure 3-2. Select "My computer -> Properties"]


System Properties
System Restore
Automatic Updates
Remote
General
Computer Name
Hardware
Advanced
Device Manager
The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.
Device Manager
Drivers
Driver Signing lets you make sure that installed drivers are compatible with Windows. Windows Update lets you set up how Windows connects to Windows Update for drivers.
Driver Signing
Windows Update
Hardware Profiles
Hardware profiles provide a way for you to set up and store different hardware configurations.
Hardware Profiles
OK
Cancel
Apply

[Figure 3-3. Select "Hardware -> Device Manager"]



[Figure 3-4. "Device Manager" window]

The item "USB 2.0 Root Hub" should be shown in the "Device Manager" window as shown in [Figure 3-4]. After checking the PC environmental conditions for USB-FRM02, do the following steps to install the board

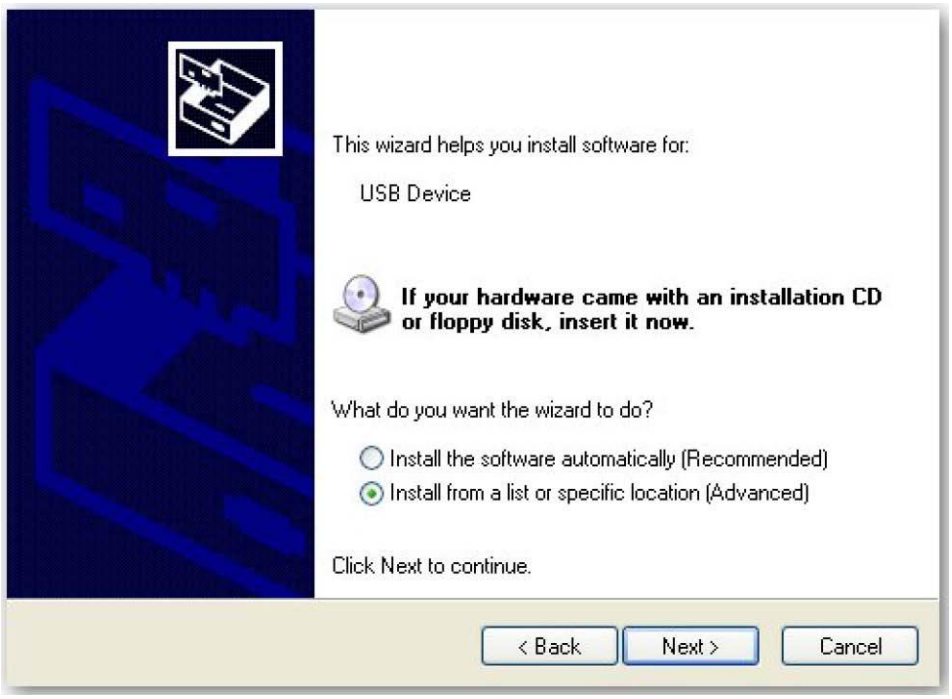
(1) Install the USB-FRM02 board into your system.

(2) Power on the frame grabber.

(3) Confirm the LED(D1) and LED3 on the USB-FRM02 board turns on.

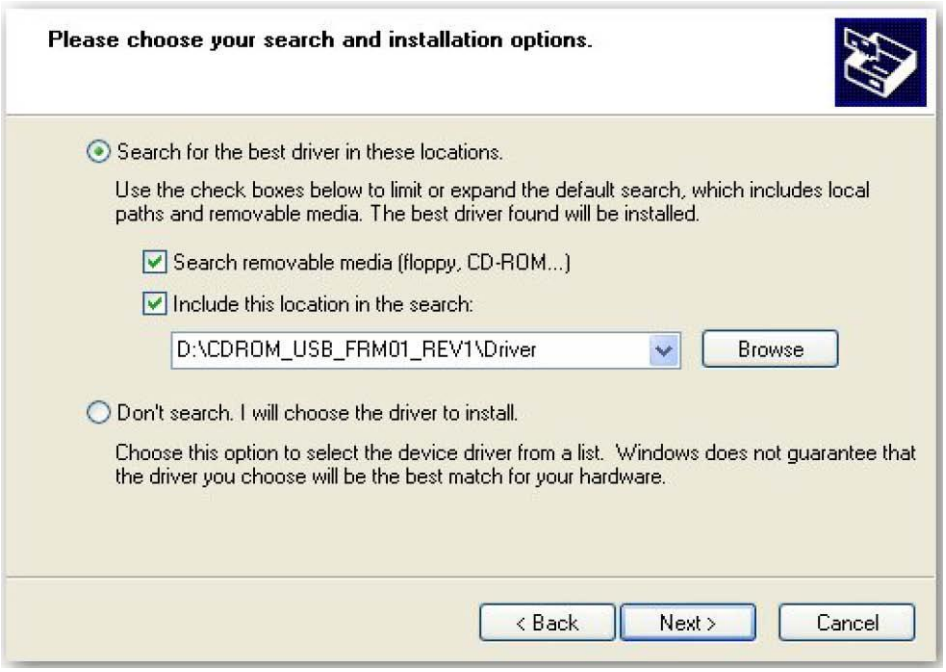
(4) Connect USB A-B cable between the case and your PC.
The Add New Hardware Wizard will appear in order to install the driver for new hardware.

(5) The Add new Hardware Wizard will install the driver in the following process. The following install process is explained based on Windows XP operating system.


This wizard helps you install software for:
USB Device
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

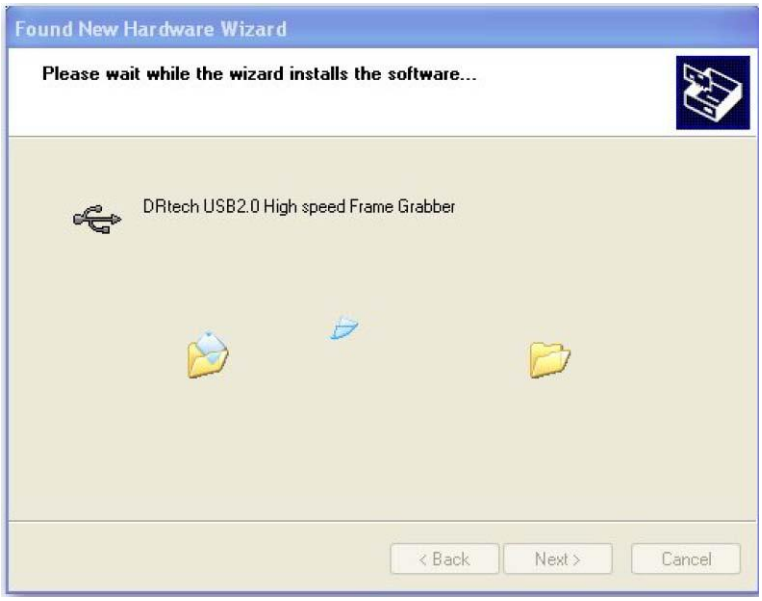
[Figure 3-5. "Hardware Wizard" window]

If new hardware is found, Wizard will ask you to install the corresponding driver, For installation of the driver, select item "Install from a list or specific location(Advanced)" and click "Next" as in the [Figure 3-5].


Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
D:\CDROM_USB_FRM01_REV1\Driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

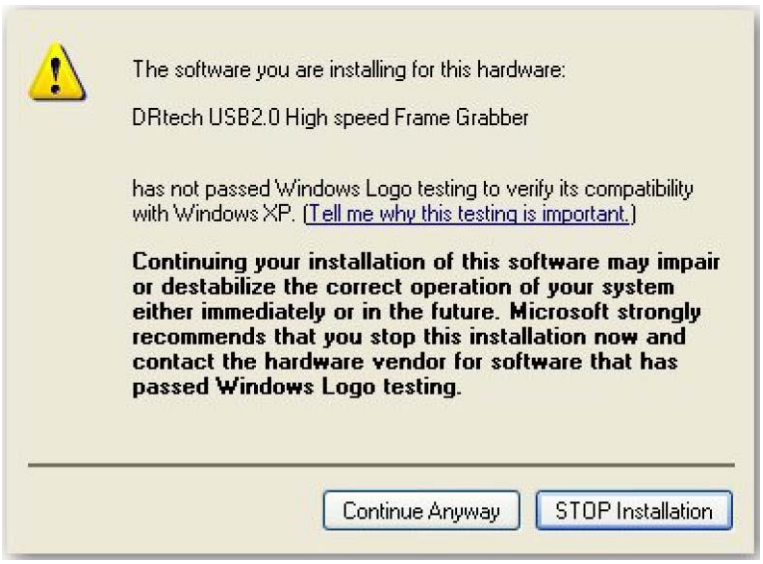
[Figure 3-6. Specify the driver folder]

Select “Search for the best driver in these locations”. Check “Search removable media (floppy, CD-ROM)”. Check “include this location in the search”. Click “Browse” button. Select the folder where the drivers are located. Click “OK”. Click “Next”.
[Figure 3-7] will be shown. The necessary files are **“usb_frm02.inf”** and **“usb_frm02.sys”** in the driver polder.


Found New Hardware Wizard
Please wait while the wizard installs the software...
DRtech USB2.0 High speed Frame Grabber
< Back
Next >
Cancel

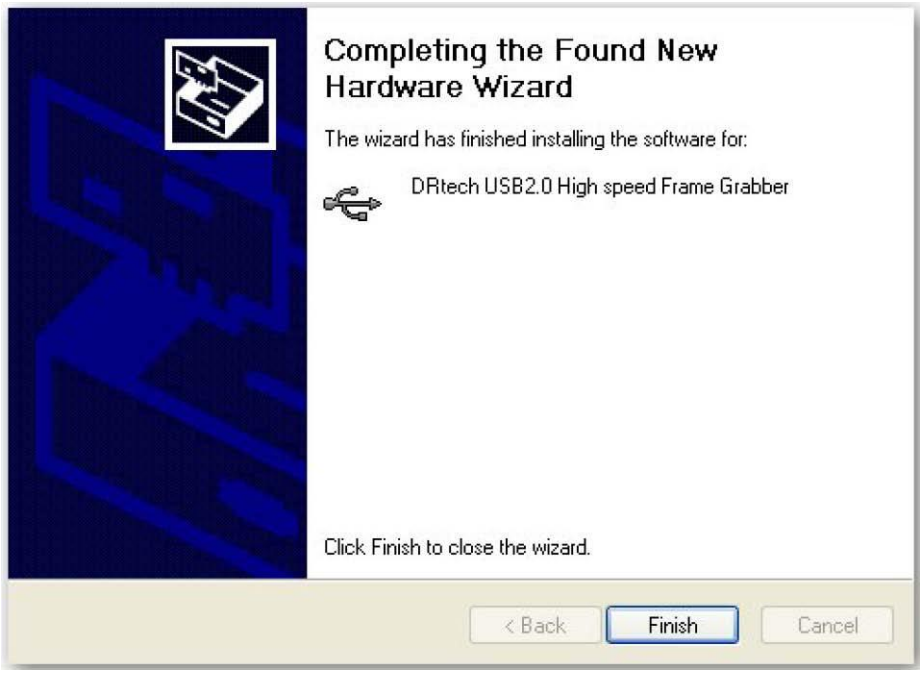
[Figure 3-7. “Device Manager” window]

When you across a window’s warning message regarding to the compatibility problem as shown the [Figure 3-8] during the installation process, just click “Continue” button and go on the installation.


The software you are installing for this hardware:
DRtech USB2.0 High speed Frame Grabber
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

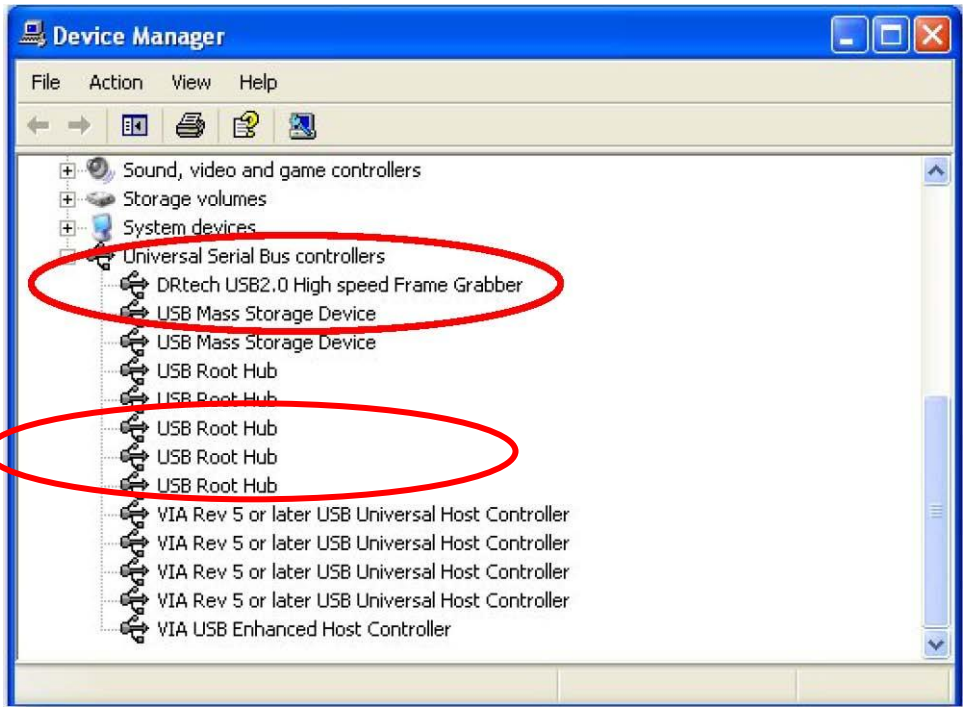
[Figure 3-8. Warning window]

If the installation is completely finished, a completion window message shall be shown as in [Figure 3-9]. Click “Finish”.


Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
DRtech USB2.0 High speed Frame Grabber
Click Finish to close the wizard.
< Back
Finish
Cancel

[Figure 3-9. “Completion” message window]

If you successfully complete the wizard, you can find the item **“DRTech USB2.0 High speed frame grabber”** in the “Device Manager” window as shown in [Figure 3-10].

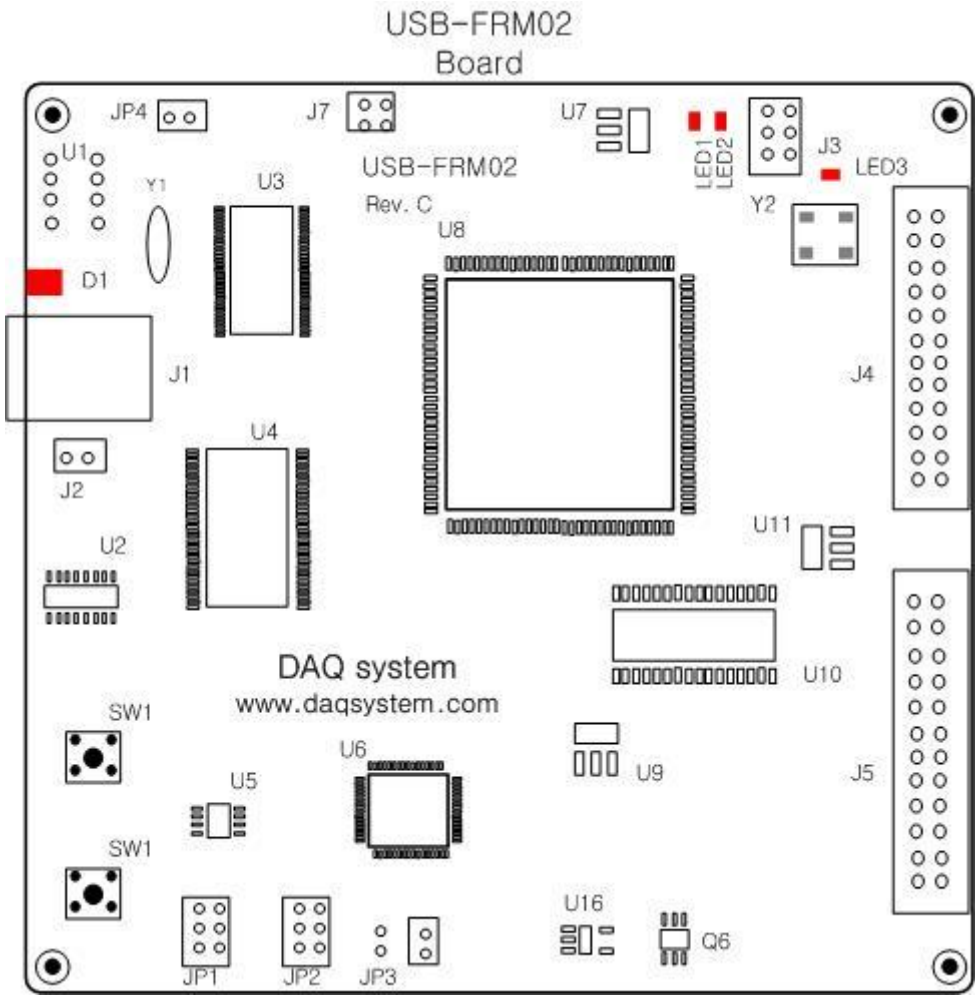

Device Manager
File Action View Help
Sound, video and game controllers
Storage volumes
System devices
Universal Serial Bus controllers
DRtech USB2.0 High speed Frame Grabber
USB Mass Storage Device
USB Mass Storage Device
USB Root Hub
USB Root Hub
USB Root Hub
USB Root Hub
USB Root Hub
VIA Rev 5 or later USB Universal Host Controller
VIA Rev 5 or later USB Universal Host Controller
VIA Rev 5 or later USB Universal Host Controller
VIA Rev 5 or later USB Universal Host Controller
VIA USB Enhanced Host Controller

[Figure 3-10. “Device Manager” window]

4. USB-FRM02 Description

In this chapter, the primary functions of the board are described briefly. For more information, refer to the device specification.

4.1 USB-FRM02 Layout



[Figure 4-1. USB-FRM02 PCB layout]

The board has four LEDs to indicate the operation status.

D1 : turns on when power is applied to the board.

LED1 : turns on whenever the board receives the frame image data.

LED2 : turns on whenever the board is transmitting the received frame image data to your PC.

LED3 : turns on when power is applied and the FPGA is ready to run.

4.2 Description of the functional blocks

(1) **FPGA**

All of the functions are controlled by the logic program of the FPGA.

(2) **USB2.0 SIE**

This block supports USB2.0 High speed interface.

(3) **EEPROM**

The EEPROM contains 8051 firmware for USB2.0 SIE.

(4) **SDRAM**

The SDRAM is for saving the image frame data. The size of one frame data is 6MByte for DXD810 mode and 16MByte for DXD1417 mode.

(5) **Regulator**

The Regulator is for supplying the power (3.3V) to the board.

(6) **Level Shifter**

It is protected a circuit that the interface of high voltage higher than 3.3V CMOS Logic is exchanged to normal 3.3V Logic Level.

(7) **EPLD**

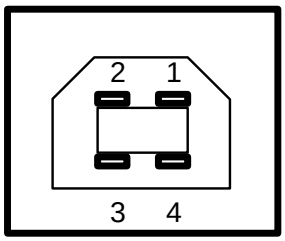
The EPLD makes a circuit for the FPGA.

4.3 Connector Pin-out

The board has several connectors and jumpers to set.

[J1 Connector]

J1 is a USB-B type connector for high speed USB connection. [Figure 4-2] and [Table 1] shows the J1 connector and its pin description.

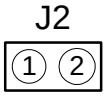


[그림 4-2. J1 Connector (USB-B type Front View)]

[Table 1. USB-B Connector]

Pin	Signal Name	Description	Remark
1	**VCC**	USB power +5V	Not used
2	**D-**	USB signal Minus(Negative)	
3	**D+**	USB signal Plus(Positive)	
4	**GND**	USB power GND	

[J2 Jumper]



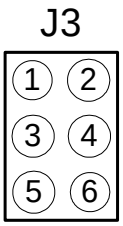
[그림 4-3. J2 Jumper (Top View)]]

The USB-FRM02 board has powered through J5's flat cable at normal operation. However, when the board is tested alone, a short pin can be installed on J2 pins and the power can be drawn from PC through USB connector.

Important notice : Never install J2 jumper while J5 flat cable is connected.
(It can be damaged PC.)

[J3 Connector]

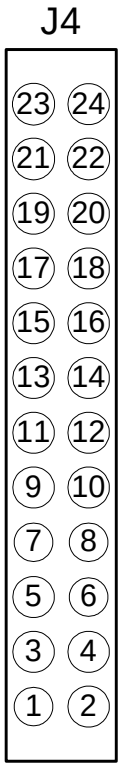
J3 is used for the board self-test or the production line. Do not use at the normal operation. [Figure 4-4] shows the J3 connector.



[Figure 4-4. J3 Connector (Top View)]

[J4 Connector]

J4 is a 24 pin header for general purpose I/O. The I/O direction of each pin is determined by API. [Figure 4-5] and [Table 2] shows the J4 connector and its pin description.



[Figure 4-5. J4 Connector (Top View)]

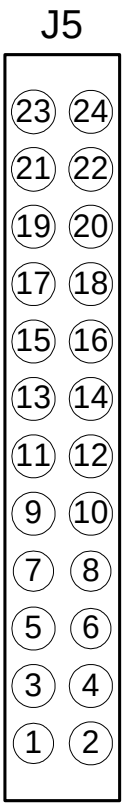
[Table 2. J4 PIN-OUT Description]

Pin	Signal Name	Description	Remark
1	**IO_00**	General Purpose I/O 00	3.3V CMOS Logic
2	**IO_01**	General Purpose I/O 01	3.3V CMOS Logic
3	**IO_02**	General Purpose I/O 02	3.3V CMOS Logic
4	**IO_03**	General Purpose I/O 03	3.3V CMOS Logic
5	**IO_04**	General Purpose I/O 04	3.3V CMOS Logic
6	**IO_05**	General Purpose I/O 05	3.3V CMOS Logic
7	**IO_06**	General Purpose I/O 06	3.3V CMOS Logic
8	**IO_07**	General Purpose I/O 07	3.3V CMOS Logic
9	**IO_08**	General Purpose I/O 08	3.3V CMOS Logic
10	**IO_09**	General Purpose I/O 09	3.3V CMOS Logic
11	**IO_10**	General Purpose I/O 10	3.3V CMOS Logic
12	**IO_11**	General Purpose I/O 11	3.3V CMOS Logic
13	**IO_12**	General Purpose I/O 12	3.3V CMOS Logic
14	**IO_13**	General Purpose I/O 13	3.3V CMOS Logic
15	**IO_14**	General Purpose I/O 14	3.3V CMOS Logic
16	**IO_15**	General Purpose I/O 15	3.3V CMOS Logic
17	**N.C.**	No Connection	Never Use this pin
18	**N.C.**	No Connection	Never Use this pin
19	**N.C.**	No Connection	Never Use this pin
20	**N.C.**	No Connection	Never Use this pin
21	**GND**	Board Ground	
22	**+5V**	Board Power(+5V)	
23	**GND**	Board Ground	
24	**+5V**	Board Power(+5V)	

[J5 Connector]

J5 is a 24 pin header connector for receiving the image frame data and supplying the power to the board. It also has the pins for UART communication.

[Figure 4-6] and [Table 3] show the J5 connector and its pin-map.



[Figure 4-6. J5 Connector (Top View)]

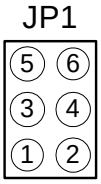
[Table 3. J5 Connector Pin Description]

Pin	Signal Name	Description	Remark
1	**DATA00**	Frame Data 00	3.3V CMOS Logic
2	**DATA01**	Frame Data 01	3.3V CMOS Logic
3	**DATA02**	Frame Data 02	3.3V CMOS Logic
4	**DATA03**	Frame Data 03	3.3V CMOS Logic
5	**DATA04**	Frame Data 04	3.3V CMOS Logic
6	**DATA05**	Frame Data 05	3.3V CMOS Logic
7	**DATA06**	Frame Data 06	3.3V CMOS Logic
8	**DATA07**	Frame Data 07	3.3V CMOS Logic
9	**DATA08**	Frame Data 08	3.3V CMOS Logic
10	**DATA09**	Frame Data 09	3.3V CMOS Logic

11	**DATA10**	Frame Data 10	3.3V CMOS Logic
12	**DATA11**	Frame Data 11	3.3V CMOS Logic
13	**DATA12**	Frame Data 12	3.3V CMOS Logic
14	**DATA13**	Frame Data 13	3.3V CMOS Logic
15	**HSYNC**	Horizontal sync.	3.3V CMOS Logic
16	**VSYNC**	Vertical sync.	3.3V CMOS Logic
17	**CLOCK**	Frame clock 20Mhz	3.3V CMOS Logic
18	**LDV**	Line Valid (not used)	3.3V CMOS Logic
19	**RXD**	UART Receive	3.3V CMOS Logic
20	**TXD**	UART Transmit	3.3V CMOS Logic
21	**GND**	Board Ground	
22	**+5V**	Board Power(+5V)	
23	**GND**	Board Ground	
24	**+5V**	Board Power(+5V)	

[JP1 Connector]

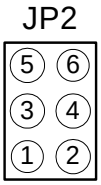
JP1 connector is used for the FPGA program upgrade. Never use it at the normal operation. [Figure 4-7] shows the JP1 connector.



[Figure 4-7. JP1 Connector (Top View)]

[JP2 Connector]

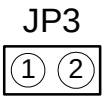
JP2 connector is used for FPGA functional test. Never use it at the normal operation. [Figure 4-7] shows the JP2 connector.



[Figure 4-8. JP2 Connector (Top View)]

[JP3 Jumper]

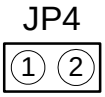
JP3 jumper should be shorted when upgrading FPGA program. Never use it at the normal operation. [Figure 4-9] shows the JP1 connector.



[Figure 4-9. JP3 Jumper (Top View)]

[JP4 Jumper]

JP4 jumper determines the status of write-protection of the EEPROM.
It is recommended that JP4 be open at the normal operation. [Figure 4-10] shows the JP4 jumper.



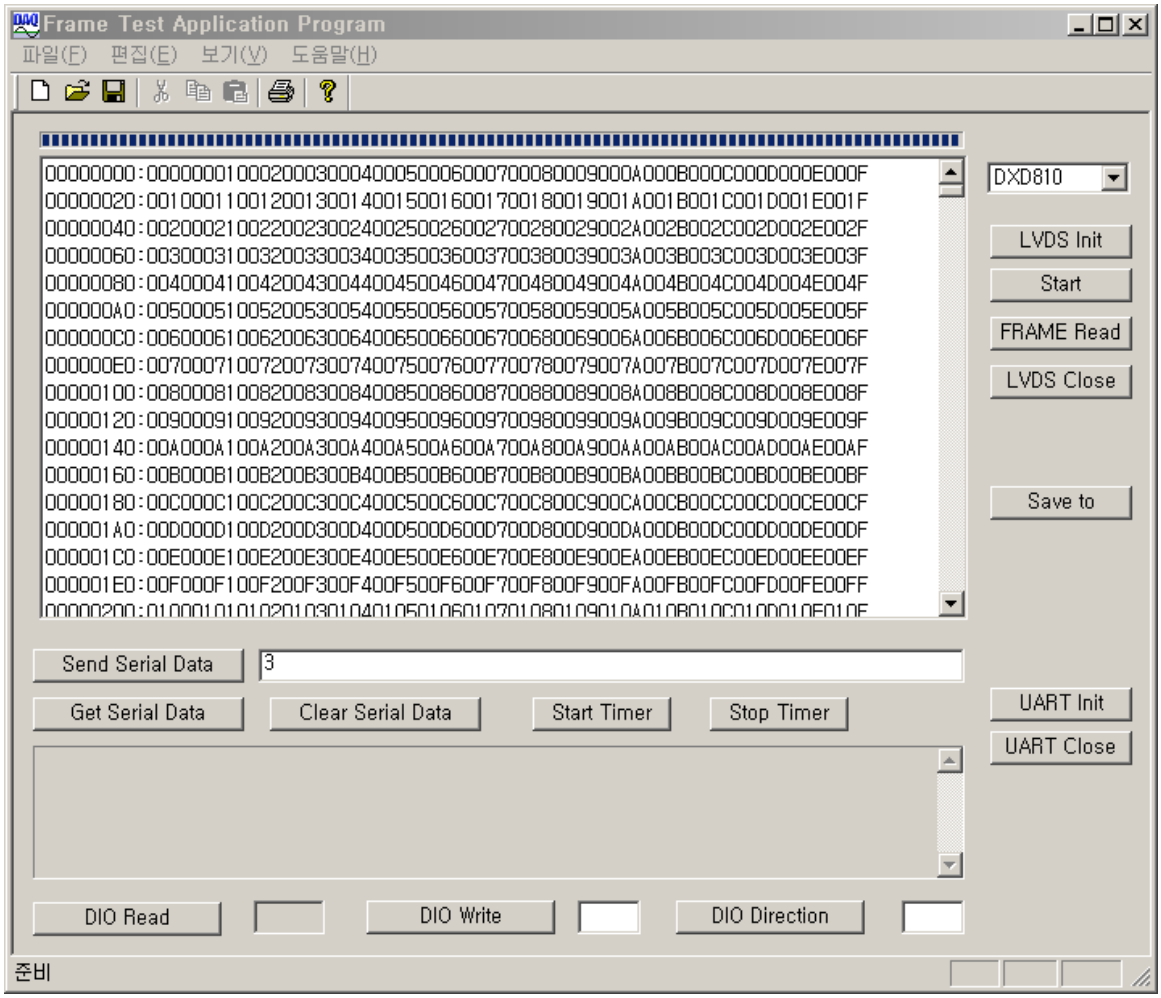
[Figure 4-10. JP4 Jumper (Top View)]

OPEN : Write protection. Normal status
SHORT: Writing possibility.

4.4 Sample Program

A sample program is provided to make the user get familiar with the board operation and to make the program development easier. You can find the sample program in the CDROM. Before using it, you have to install the board and its driver in your computer properly.

Sample program is provided in source form in order to show the usage of API(Application Programming Interface) of the board and may be modified for customer's own usage.



[Figure 4-11. Main window of the sample program]

To run the sample application program, you need to use API (Application Programming Interface), which is a form of client DLL (Dynamic Link Library). To compile the sample source to make its executable file, you have to use Import Library files and header files. You can find them in the CD-ROM. To run the execution file, the API DLL **(USB_FRM02.DLL)** must be in the same directory with the execution file or in Windows system folder. Another method is to add the directory of API DLL file to PATH environmental variable.

4.4.1 Functions related to image frame

(1) **DXD810/DXD1417 Combo-box**

Use this box to select the operation mode (DXD810 mode or DXD1417 mode).

(2) **'LVDS Init' button**

When press this button, it initializes the function of receiving image frame data. It is performed only once after power is applied to the board.

(3) **'Start' button**

When press this button, it start to save the image frame.

(4) **'FRAME Read' button**

When press this button, it reads the image frame data saved image frame. If image data is not saved on the board, you must wait until the completion of data acquisition.

(5) **'LVDS Close' button**

Press this button to finish usage of the board and terminate the program.

(6) **'Save to' button**

When press this button, it saves the frame data as a file on disk.

4.4.2 Functions related to UART

(1) **'Send Serial Data' button and editor box**

Press this button to send the serial data in the editor box to the frame grabber through UART interface. You can directly write the data in the editor box beside the button.

(2) **'Get Serial Data' button**

Press this button to get the serial data from the frame grabber. If there is received serial data from the frame grabber, it will be displayed in the editor box below the button.

(3) **'Clear Serial Data' button**

Press this button to clear the contents of the editor box.

(4) **'Start Timer' button**

Press this button to start the timer. The sample program will read the UART data. The reading interval is around 100ms.

(5) **'Stop Timer' button**

Press this button to stop periodical reading of UART data.

(6) **'UART Init' button**

Press this button initialize UART. It must be performed only once after power is applied to the board.

(7) **'UART Close' button**

Press this button to finish usage of the board and terminate the program.

4.4.3 Functions related to DIO

(1) **'DIO Read' button**

Press this button to read the data on General purpose I/O ports. The I/O status is displayed on the editor box.

(2) **'DIO Write' button**

Press this button to write the data in the editor box to General purpose I/O ports.

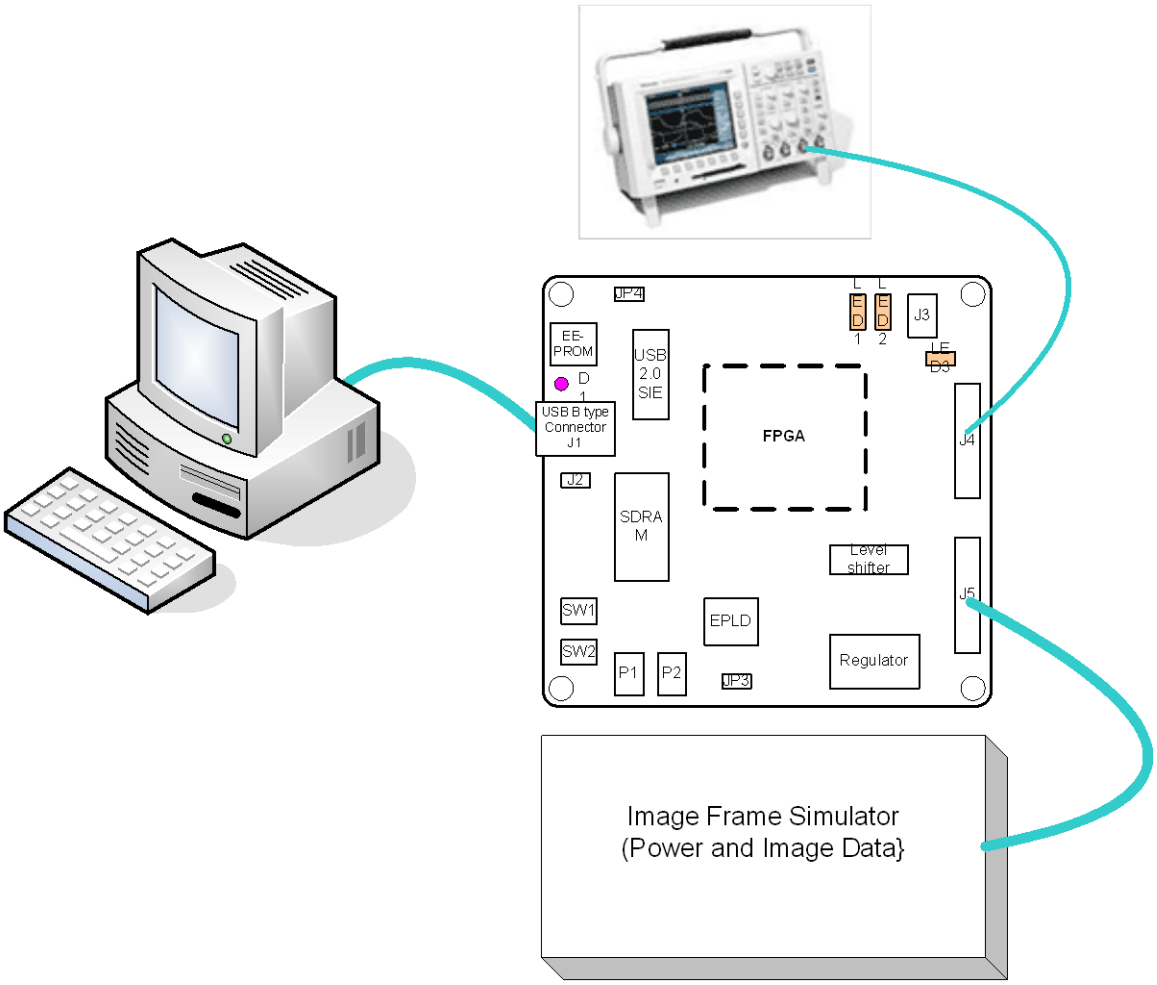
(3) **'DIO Direction' button**

Press this button to determine the I/O direction of General purpose I/O ports. If you write '0' to the right empty box, the port will install the input port. Otherwise, the port will install the output port. For example, if you write the value '0x0001' in the editor box, port 0 shall be output port and the rest of the ports shall be input port.

5. Test

5.1 Image Frame Test

In this chapter, the functional test will be explained. It is performed by the sample program **"FrmTest.exe"** on the PC equipped with the USB-FRM02 board.



[Figure 5-1. Equipment connection for the test]

[Figure 5-1] shows the connection of the equipments. The USB-FRM02 board receives power and image data from Frame Data Generator(Simulator). After completion of connecting the necessary materials, power up and execute the test program "FrmTest.exe" on your PC.

Follow the steps to test the function of receiving image frame data.

(1) Press the "LVDS init" button to initialize the LVDS circuit and then press the 'Start' button to save Image Frame data from Image Frame Simulator on the USB-FRM02

board.

(2) Press the “Frame Read” button. Then data are displayed on editor box. Compare the contents of the editor box with the data of Image Frame Simulator. Comparison can be performed using the “Save to” button. It saves the contents of the editor box to a file.

5.2 UART Tx/Rx Test

At the above figure [4-11], the Image Frame Simulator send to serial data to the board periodically.

(1) Press the ‘UART init’ button to initialize the UART and then press the “Start Timer” button to get the UART data from the Image Frame Simulator. Then the gotten data are displayed on the editor box below button. Compare the contents of the editor box with the data of the Image Frame Simulator.

(2) Write a data to the editor box beside the “Send Serial Data” and press button to send it to the Image Frame Simulator via the UART. Compare the data on the editor box with that of the Image Frame Simulator.

5.3 DIO Input/Output test

At the above figure [4-11], write a “0xFFF” to the editor box of the “DIO Direction” button and press button to make all ports being output mode.

(1) After to make all output port “1’’ using “DIO Write” function of the test program, check the output state using the oscilloscope or check the write data using “DIO Read” function. And then again to make all output port “0” using “DIO Write” function of the test program, check the output state using the oscilloscope or check the write data using “DIO Read” function.

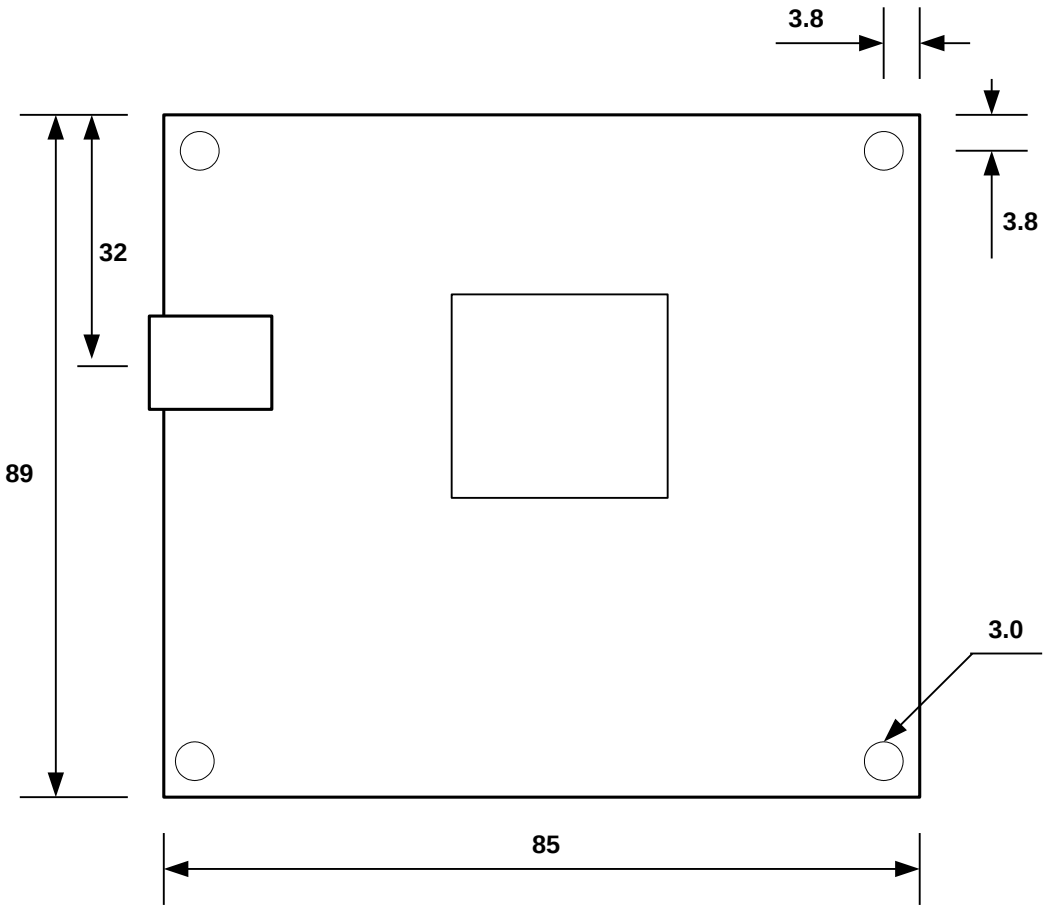
(2) Write a “0x0” to the editor box beside the “DIO Direction” button and press button to make all output being input mode. Each port pulls up or pulls down through 4.7K resistor and then checks all ports using “DIO Read” function.

Appendix

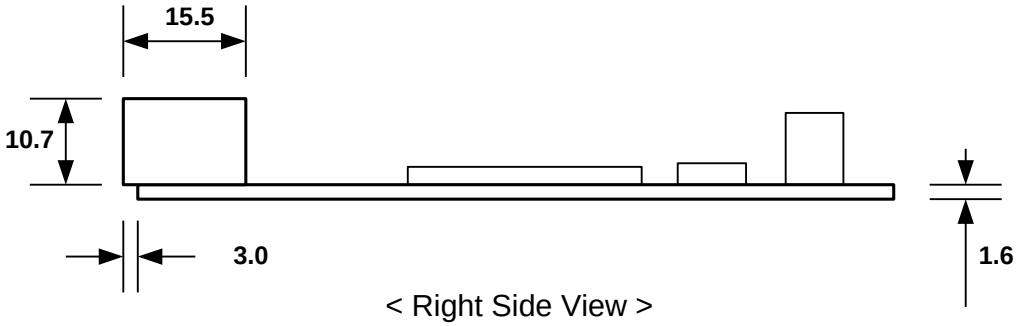
A.1 General Specification

Specification	
General	• USB 2.0 Specification • High Speed Device 480Mbps • 8051 Compatible Instruction Set, 4 Clock per Cycle • 32MB SDRAM
Interface	• +5V Single Power operation Max 300mA under • 3.3V CMOS 16bit General Purpose I/O • 3.3V CMOS Camera-Link Interface.
Functions	• 14bit Image Frame Acquisition • Transmit Image Frame Data to PC • 9600bps UART Rx/Tx
Software	
Supported OS	Windows 2000 SP4 and Windows XP SP1 above
API	Interface with Application through client DLL
Sample Software	Test Sample software for evaluation

A.2 Physical Dimension



< Top View >



< Right Side View >

References

1. USB 2.0 System Architecture

-- Don Anderson, USB SIG(www.usb.org)

2. Universal Serial Bus Specification

-- Compaq/Intel/Microsoft/NEC, MindShare Inc. (Addison Wesley)

3. AN201 How to build application using API

-- DAQ system

4. AN342 USB-FRM02 API ver1.0

-- DAQ system